REMARKS

Reconsideration and allowance of the claims in the application are requested.

Claims 1-21 are in the case.

Claims, 10, 11, 12-20 have been objected to because of informalities.

Claims 1-8, 21 have been rejected under 35 USC 103(a) as unpatentable over USP 6,314,113 B1 to P. Guemas, issued November 6, 2001, filed May 21, 1998 (Guemas), in view of USP 6,021,110 to G. McGibney, issued February 1, 2000, filed January 26, 1999 (McGibney).

Applicants note the allowance of claims 9-11, if rewritten in independent form, including all of the limitations of the base claim and any intervening claims. Claim 9 has been cancelled without prejudice and re-written as claim 22, including all of the limitations of original claim 1. Claims 10 and 11 have been amended to depend on claim 22.

Applicants have amended claims 10-21 to overcome the objections. A revised Abstract has been provided, which does not exceed one hundred fifty words. Formal drawings overcoming the Draftsperson's comments have been enclosed. Claims 1, 10-12 and 21 have been amended to overcome the cited art.

Before responding to the rejections, Applicants would like to distinguish Guemas and McGibney from the present invention (Cupo), as follows:

1. Guemas discloses frame synchronization in an OFDM system using a time domain representation of an OFDM signal. A transmitter repeats a number of samples of useful data in a guard period. At the receiving end, the baseband signal in a time domain is sampled at a clock frequency that is as close to a sampling frequency of the transmitter end as possible. A window is selected as an arbitrary sampling instant with an arbitrary sample number and having a width that is equal to the total symbol period of an OFDM frame. The correlation of the samples

is calculated and the window is moved one sample to the right and the correlation is computed again. The process is repeated until the end of the window is reached. The sample number, which the correlation is maximized indicates the beginning of a frame and at this point frame synchronization is achieved. Guemas fails to disclose elements of Cupo, as follows:

A. Guemas discloses time synchronization device 119 having first and second channels including correlation cells, which calculate the correlation signals. Threshold detectors in each channel determine whether the correlation signals are higher or lower than a given threshold over which significant correlation is to be taken into account. A controller determines the start of the OFDM symbol. In contrast, Cupo discloses auto correlation values are averaged over L symbols and saved in an L-frame FIFO for two or more frames, typically 11. A frame synchronization estimator uses the amplitude of the auto correlation values to estimate the frame boundaries. Guermas fails to disclose a correlator, L-Fame and Frame estimator interacting to determine the frame boundary.

B. Guemas discloses a time synchronization device, which provides an output signal indicative of the duration of a guard interval. A calculation unit measures the offset that exists between the correlation maximum and the start of the correlation window, as shown in Fig. 8. In contrast, Cupo discloses a phase lock loop that provides a sample number indicating an OFDM frame boundary. Guemas fails to disclose a phase lock loop providing an output signal pointing to an ODFM frame boundary.

C. Guermas fails to disclose means for correcting frequency and timing offset between the receiver and the transmitter. In contrast, Cupo discloses a phase lock loop generates an output signal locked to the transmitter and a programmable counter provides a receiver clock chain locked to the transmitter. Page 8, L 1 – 3. Guermas fails to disclose an ODFM <u>receiver</u>

which is locks itself to the transmitter signal.

2. McGibney discloses a synchronizing apparatus for a differential OFDM receiver that simultaneously adjust the radio frequency and sample clock frequency using a voltage control crystal oscillator to generate a common reference frequency. McGibney determines the frequency offset in the frequency domain and computes and corrects the offset error by measuring how much each constellation of an OFDM signal has rotated from an ideal position. The measurement is used to adjust the oscillator. McGibney fails to disclose elements of Cupo, as follows:

A. McGibney discloses adjusting a voltage controlled oscillator to correct for offset. In contrast, Cupo discloses computing a correlation function for each frame and using its phase angle to correct the timing and frequency offset. Page 8, lines 5-13.

B. McGibney discloses a base station measures the transmitter- receiver timing error and signals the receiver to adjust the transmission. Col. 8, L 14 – 18. In contrast, Cupo discloses a phase lock loop and programmable counter locking the transmitter and the receiver.

Summarizing, Guemas and McGibney, alone or in combination, fail to disclose or suggest a phase lock loop providing a sample number indicating an OFDM boundary and an output locked to the transmitter as an input to a programmable counter for generating a receiver clock phase locked to the transmitter signal. Without a disclosure of the foregoing elements in Guemas and McGibney, there is no basis for a worker skilled in the art to implement claims 1-21 and the rejection under 35 USC 103(a) fails for lack of support. Withdrawal of the rejection of claims 1-8, 10-22 are requested.

Now returning to the rejections, Applicants respond to the indicated paragraphs of the

Office Action, as follows:

REGARDING PARAGRAPHS 1, 2 & 3:

Claims 10, 11 and 12 have been amended to overcome the objections indicated by the Examiner. Withdrawal of the rejections of claims 10, 11 and 12 and dependent claims 13-20 are requested.

REGARDING PARAGRAPHS 4 & 5:

Claims 1-8, 21, include elements not disclosed in Guemas in view of McGibney, as follows:

(a) Claims 1, 12 & 21:

(i) "means for averaging and saving in an L frame FIFO, where L is at least two (2), the auto correlation values of the I and Q components over K symbols and determining which of the K average value is the maximum for computing the correlation values"

Guemas discloses a transmitter repeats a number of samples, K2 of useful data. At the receiving end, the baseband signal in a time domain is sampled at a clock frequency that is as close to the sampling frequency at the transmitter end as possible. A window starting at an arbitrary sampling instant and having a width that is equal to the total symbol period of an ODM frame, calculates the correlation. The window is then moved one sample to the right and the correlation is computed again. The process is repeated until the end of the window is reached. The sample number in which the correlation is maximum indicates the beginning of the frame. In contrast, Cupo saves the correlation values in an L frame FIFO, where L varies and is at least two, the running average of the correlation values being taken over the L frame and the K

average value with the maximum is used for computing the correlation values. Guemas computes the auto correlation values recursively. Col. 7, lines 21-6. Moreover, the computed correlation values are not averaged over multiple frames as there does not appear to be any disclosure where the elements are saved before averaging is performed. Guemas fails to disclose saving the auto correlation values in an L framed FIFO, where L is at least two and determining over the saved K symbols the maximum for computing the correlation values.

(ii) "phase lock loop means for providing a sample number indicating an OFDM frame boundary using the average I and Q auto correlation values and providing an output signal locked to the transmitter RF signal;"

Guemas discloses at col. 4, lines 35-47, a demodulator that determines the maximum correlation occurring in the first and second sequences of complex symbols, a first occurrence of a group of complex symbols and a second occurrence of the same group of compound complex symbols, the two occurrences having a like duration. Claim 3, lines 27-50 and lines 15-21. In contrast, Cupo discloses a phase lock loop receiving estimated frame boundaries p_1 and p_2. The difference $p_1 - p_2$ is obtained in a summing circuit and saved in a FIFO. The saved differences are averaged over eight latest frames; passed through a filter, and integrated to round off the nearest integer value to provide an input to a counter, which provides a sample number or pointer for a desired frame boundary. Page 7, lines 17-25. Further, the phase lock loop provides an output signal locked to a transmitter RF signal. Page 8, lines 1-3. Guemas fails to disclose a phase lock loop generating a sample number represented over by frame boundary for correspondence between transmitted frames and received frames. Moreover, Guemas does not disclose a time synchronization device providing an output signal locked to the transmitter RF signal.

(iii) "means providing a receiver clock chain output phase locked to the transmitter RF signal"

Applicants can find no disclosure in Guemas relating to providing a receiver clock chain output phase locked to the transmitter RF signal. Guermas discloses the base transmitter adjusts the transmitter to lock to the receiver.

(iv) "means calculating in the time domain an offset value indicative of a phase difference between the receiver and a transmitter;"

McGibney discloses at col. 3, lines 48-67 and col. 4, lines 7-13 and col. 5, lines 45-67, col. 7, lines 10, 57-60, frequency offset is estimated in the frequency domain. McGibney computes and corrects the timing error (Fig. 4, element 58 and col. 4, lines 9-34) by estimating the data from the phase angle and removing it. The time domain signal is converted into the frequency domain by taking the FFT of the sample inputs after frame synchronization has been achieved and the incoming OFDM signal is demodulated. The timing error is estimated by measuring how much each constellation of the OFDM signal has rotated from the ideal by vector averaging it and using this information to adjust a reference oscillator. In contrast, Cupo determines frequency offset using an offset correcting circuit, which modifies the amplitude and phase of each sample stored in a FIFO to correct for frequency synchronization, frame synchronization, and transmitter/frequency offset, as described in the specification at page 8, lines 5-13. McGibney fails to disclose a phase lock loop and programmable counter in the receiver for locking the transmitter and receiver.

Summarizing, Guemas, in view of McGibney, failed to disclose items (i)...(iv), and without such disclosure, there is no basis for a worker skilled in the art to implement claims 1, 12 and 21. Withdrawal of the rejection of claims 1, 12 and 21 and allowance thereof are requested.

B. Claims 2 & 13:

Claims 2 and 13 further limit claims 1 and 12 and are patentable on the same basis thereof.

C. Claims 3, 15 & 16:

(i) "means for phase locking the transmitter and the receiver using a programmable counter locked to the transmitter and a counter responsive to a receiver clock change."

McGibney discloses at col. 7, lines 57-59, tying a transmitter clock directly to its receiver clock, which works until the devices move far enough apart that the propagation delay between them becomes significant. To correct this condition, a base station measures timing error created by the communication channel, and transmits through a digital control channel the results back to the terminal, where the transmit timing can be adjusted. In contrast, Cupo discloses a programmable counter, locked to a transmitter and a counter responsive to receiver clock change for phase locking the transmitter and the receiver. McGibney fails to disclose a receiver for locking itself to the transmitter.

D. Claim 4:

Claim 4 further limits claim 1 and is patentable on the same basis thereof.

E. Claims 5 & 14:

(i) "means responsive to the sample number and negative phase angle of the auto correlation values for correcting for frequency synchronization, frame synchronization and transmitter/frequency offset"

McGibney calculates frequency offset in a frequency domain, whereas, Cupo calculate frequency offset in the time domain, as discussed in connection with distinguishing

claim 1 from McGibney.

F. Claim 6:

Claim 6 further limits claim 1 and is patentable on the same basis thereof.

G. Claim 7 & 17:

(i) "means for storing a sample I and Q components coupled to the auto correlation means and an offset correcting means."

Guemas discloses correlating cells, including memory and providing an output to a threshold circuit (Fig. 8). In contrast, Cupo discloses a correlator coupled to an L-frame FIFO connected to an offset circuit (Fig. 2A).

Guemas fails to disclose the elements of claims 7 and 17.

H. Claims 8 & 18:

(i) "means for storing the average auto correlation values in an L frame FIFO coupled to an offset estimator and a frame synchronization estimator."

Guemas discloses in Fig. 8, a correlation cell 20, including a storage means 220, the cell providing an output to a threshold circuit and responsive to a controller providing signals WS_{2k} and WS_{8k}. The controller determines the FFT and the guard symbol, via a calculation device 26 and the offset, via a calculating unit 222. Applicants can find no disclosure in Guemas for storing the auto correlation values in an L frame FIFO coupled to an offset estimator and a frame synchronization estimator, as described in the specification at page 6, line 25, continuing to page 7, line 12. Guemas fails to disclose the elements of claims 8 and 18.

I. Claim 19:

(i) adjusting the phase angle of each sample in an offset correction circuit by an amount proportion to "n", where "n" is counted from a correct frame boundary."

McGibney at col. 7, lines 57-59 disclose tying the transmitter to the receiver clock, as long as the two devices are not far enough apart that propagation delay between them becomes significant. Otherwise, a base station measures the timing error created by the communication channel and transmit through a digital control channel results back to a terminal, where the transmit timing can be adjusted. In contrast, Cupo discloses an offset correction circuit uses an estimated offset to adjust the phase angle of each sample of the two framed FIFO by an amount counted from the correct frame boundary. McGibney fails to disclose item (i)

(ii) "means for averaging and saving in an L frame FIFO, where L is at least two (2), the auto correlation values of the I and Q components over K symbols in determining which of the K average value is the maximum for computing the correlation values;".

McGibney fails to disclose an offset correction circuit for adjusting the phase angle by an amount proportion to "n" counted from a correct frame boundary.

J. Claim 20:

(i) "averaging the auto correlation values over frames and the storage device."

Guemas computes the auto correlation recursively, as described col. 7, lines 21-26. There is no disclosure in Guermas relating to the correlation values being averaged over multiple frames, where they are saved before averaging is preformed.

Summarizing, Guemas in view of McGibney fails to disclose (i) averaging and saving the auto correlation values of I and Q components over K symbols, and determining which of the K average values is the maximum for computing the correlation values; (ii) a phase locked loop for providing a sample number as reported to at OFDM frame boundary and providing an output signal locked to the transmitter RF signal; (iii) providing a receiver clock chain output phase

locked to the transmitter calculating in the time domain an offset value indicative of the phase difference between a receiver and a transmitter, and (iv) phase locking a transmitter and receiver using a programmable counter locked to the transmitter and the counter responsive to a receiver clock change. Without such support in Guemas and McGibney, there is no basis for a worker skilled in the art to implement claims 1-8, 12-21 and the rejection under 35 USC 103(a) fails for lack of support.

Withdrawal of the rejections of claims 1-8, 12-21 and allowance thereof are requested.

REGARDING PARAGRAPH 8:

Applicant has reviewed the prior art made of record and not relied upon. Only Okbo 6,151,369 and Taura 6,148,045 describe procedures for adjusting the frequency of a local oscillator at the receiver. However, they use a phase-reference symbol over an OFDM sub-carrier.

Applicants submit that all of the references made of record and not relied upon do not disclose the elements in claims 1-22 and are only cumulative to the cited art.

PATENTABILITY SUPPORT FOR NEW CLAIM 22:

Claim 22 is claim 1 and claim 9 combined and written in independent form. Claim 22 is patentable on the basis described by the Examiner in paragraph 7.

CONCLUSION:

Having amended the specification to correct informalities and objections to the claims; provided a revised Abstract and formal drawings; amended claims 1, 10-12 and 21 to clarify the IBOC system from the cited art and supported the patentability of new claim 22, Applicants request entry of the amendment, allowance of the Claims and passage to issue of the case.

AUTHORIZATION:

The Commissioner is hereby authorized to charge any fees or insufficient fees or credit any payment or overpayment associated with this application to IBM Deposit Account No. 13-4503, Order No. 3037-4167 CUPO-20-2.

Respectfully submitted,

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